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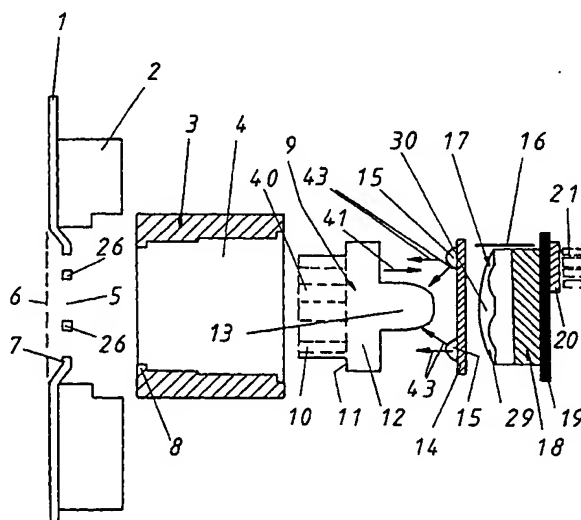
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(30) Angaben zur Priorität: 100 54 862.8 6. November 2000 (06.11.2000) DE BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,  
NL, PT, SE, TR).  
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[Fortsetzung auf der nächsten Seite]

(54) Title: ELECTRIC SWITCH, ESPECIALLY A PIEZO SWITCH, WITH OPTICAL AND/OR MECHANICAL FEEDBACK  
OF THE SWITCHING OPERATION

(54) Bezeichnung: ELEKTRISCHER SCHALTER, INSBESONDERE PIEZOSCHALTER, MIT OPTISCHER UND/ODER ME-  
CHANISCHER RÜCKMELDUNG DES SCHALTVORGANGES



(57) Abstract: The invention relates to an electric switch, especially a piezo switch, with optical and/or mechanical feedback of the switching operation. The switch contains at least one switching element, especially beneath a cover panel, which can be activated by means of an activating element. This causes a switching signal to be generated and guided out via electrical contacts. The activating element itself is configured in the form of a passive luminous body consisting of an at least translucent material, which can be illuminated by active luminous means. The mechanical feedback of the switching operation can take place using a vibrator which is activated by the switching operation that has been initiated and conveys a vibrating motion to the luminous body.

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WO 02/37516 A2

appears in parallel with Y1 is large. After switching to high sensitivity mode, the input  $g$  is continuously monitored by the controller U1, and the output  $b$  of the controller U1 is switched into a predetermined logical state which is fed into a following circuit and activates it, as long as the pulse level  $V_e$  indicates identified human hand vibrations ("1" logical state). When  $V_e$  falls to "0" (no vibrations), the output  $b$  of the controller U1 is switched back into the default (disactivating) state.

Figs. 3A and 3B schematically illustrate the voltage of the response signal, at lower and at higher sensitivities, respectively. At lower sensitivity, application of a relatively strong and continuous pressure on the element Y1, results in an analogue pulse with relatively strong amplitude (over  $A_0$ ) and limited duration (shorter than  $t_0$ ), as shown in Fig. 3A. Fig. 3B shows the same effect, but with switching to higher sensitivity at time point  $t_1$ . The resulting voltage of the response signal is kept over the level  $A_0$  as long as a continuous pressure is applied on the element Y1 by the operator (i.e., until the time point  $t_2$ ).

The above examples and description have of course been provided only for the purpose of illustrations, and are not intended to limit the invention in any way. As will be appreciated by the skilled person, the invention can be carried out in a great variety of ways, such as using other elements and/or materials which vary their electric properties in response to applied pressure, employing more than one technique from those described above, all without exceeding the scope of the invention.

3. Method according to claim 1, comprising providing the switch of a derivation to its electronic circuit and passing it from the default to the transitory mode and vice versa by changing increasing and respectively decreasing the resistance of said derivation.

4. Method according to claim 1, which comprises:

a - providing an electronic circuit, to which the pressure-sensitive element is connected, and a derivation thereof having a normal higher resistance and an alternative lower resistance;

b - setting amplitude and duration thresholds that must be at least equaled for a pulse to be an activating pulse;

c - when a voltage pulse is produced by an operator by exerting a pressure on the pressure-sensitive element, limiting and shaping said pulse;

d - sensing the amplitude and duration of said shaped pulse;

e - if said amplitude and duration are not below the predetermined thresholds, producing an activating signal;

f - concurrently, switching the electronic circuit of the switch from the default to the transitory mode by changing the resistance of said derivation from said lower to said higher value;

g - for each additional pulse above said amplitude threshold, generating an activating signal; and

h - when no further pulses above said amplitude threshold is sensed for a time exceeding a predetermined duration, returning the resistance of said derivation to its lower value.

-19-

5. Method according to any one of claims 1 to 4, wherein the pressure-sensitive element is a piezoelectric crystal.

6. Method according to any one of claims 1 to 4, wherein the pressure-sensitive switch is a piezoelectric switch.

7. Method according to any one of claims 1 to 4, wherein the pressure-sensitive element is a pressure-sensitive resistive combination operating with an applied input voltage, said combination varying its electrical characteristics in response to pressure applied thereon.

8. Method according to claim 7, wherein the pressure-sensitive resistive combination forms a resistor bridge.

9. Method according to claim 7, wherein the pressure-sensitive resistive combination is a pressure-sensitive resistor.

10. Pressure-sensitive switch apparatus, which comprises all the elements of a conventional pressure-sensitive switch, and further comprises means for changing the switch from a default mode to a temporary mode and vice versa.

11. Apparatus according to claim 10, wherein the means for changing the switch from a default mode to a temporary mode and vice versa are such that, as long as the switch is in the default mode, only the deliberate actuation thereof by a pressure exerted by an operator on the

pressure-sensitive element will produce a primary activating pulse; that once such a pulse has been detected and the primary activating pulse has been produced, the switch is passed to the transitory mode, in which the vibrations of an operator's finger are sufficient to produce secondary activating pulses; and once a predetermined time has passed without any activating pulses' being detected, the switch returns to the default mode.

12. Apparatus according to claim 11, wherein the means for passing from the default mode to the transitory mode comprise a high and a low resistance in parallel in the derivation of the electronic circuit of the switch, the low resistance being normally inserted in said derivation; means for inserting the high resistance in place of the low one to pass from the default to the transitory mode; and means for re-inserting the low resistance to return from the transitory to the default mode.

13. Apparatus according to claim 12, wherein the switch comprises a controller and the means for passing from the default mode are embodied in said controller, which is programmed to exchange the high resistance for the low one when it receives the primary activating pulse and to reverse said exchange when it detects that a predetermined time has passed without the production of secondary activating pulses.

14. Apparatus according to claim 12, wherein the low resistance is permanently inserted in the derivation of the electronic circuit and an additional resistance is provided to be inserted to pass the switch from the default to the provisional mode and disinserted to return to the default

-21-

mode, the sum of the low and the additional resistances constituting the high resistance.

15. Apparatus according to any one of claims 11 to 14, in which the pressure-sensitive element is a piezoelectric crystal.

16. Apparatus according to any one of claims 11 to 14, in which the pressure-sensitive switch is a piezoelectric switch.

17. Apparatus according to any one of claims 11 to 14, in which the pressure-sensitive element is a pressure-sensitive resistive combination operating with an applied input voltage, said combination varying its electrical characteristics in response to pressure applied thereon.

18. Apparatus according to claim 17, in which the pressure-sensitive resistive combination forms a resistor bridge.

19. Apparatus according to claim 17, in which the pressure-sensitive resistive combination is a pressure-sensitive resistor.

20. Method of producing an activating signal by exerting pressure on a pressure-sensitive element, substantially as described and illustrated.

21. Pressure-sensitive switch apparatus, substantially as described and illustrated.

1/3

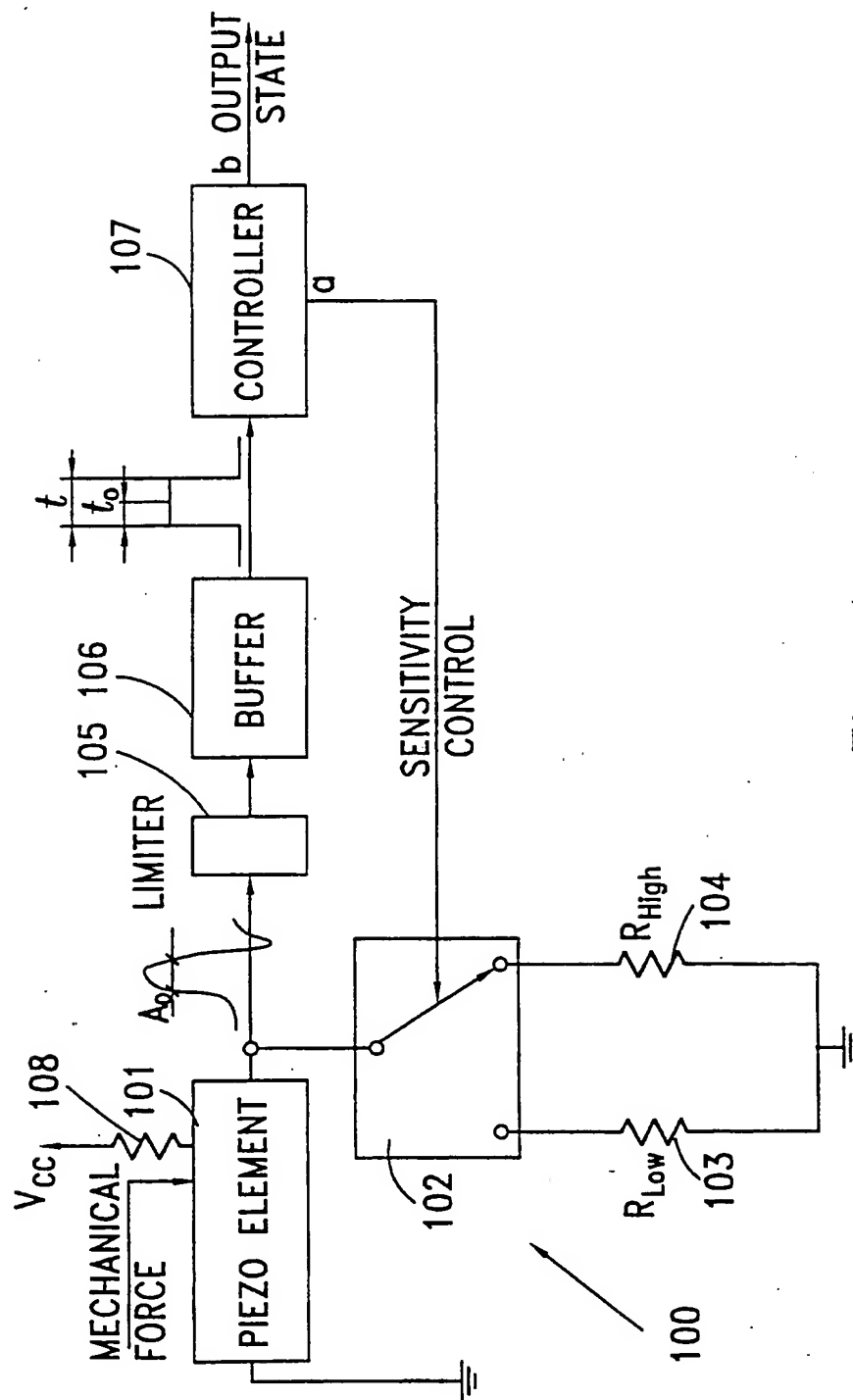


Fig. 1

2/3

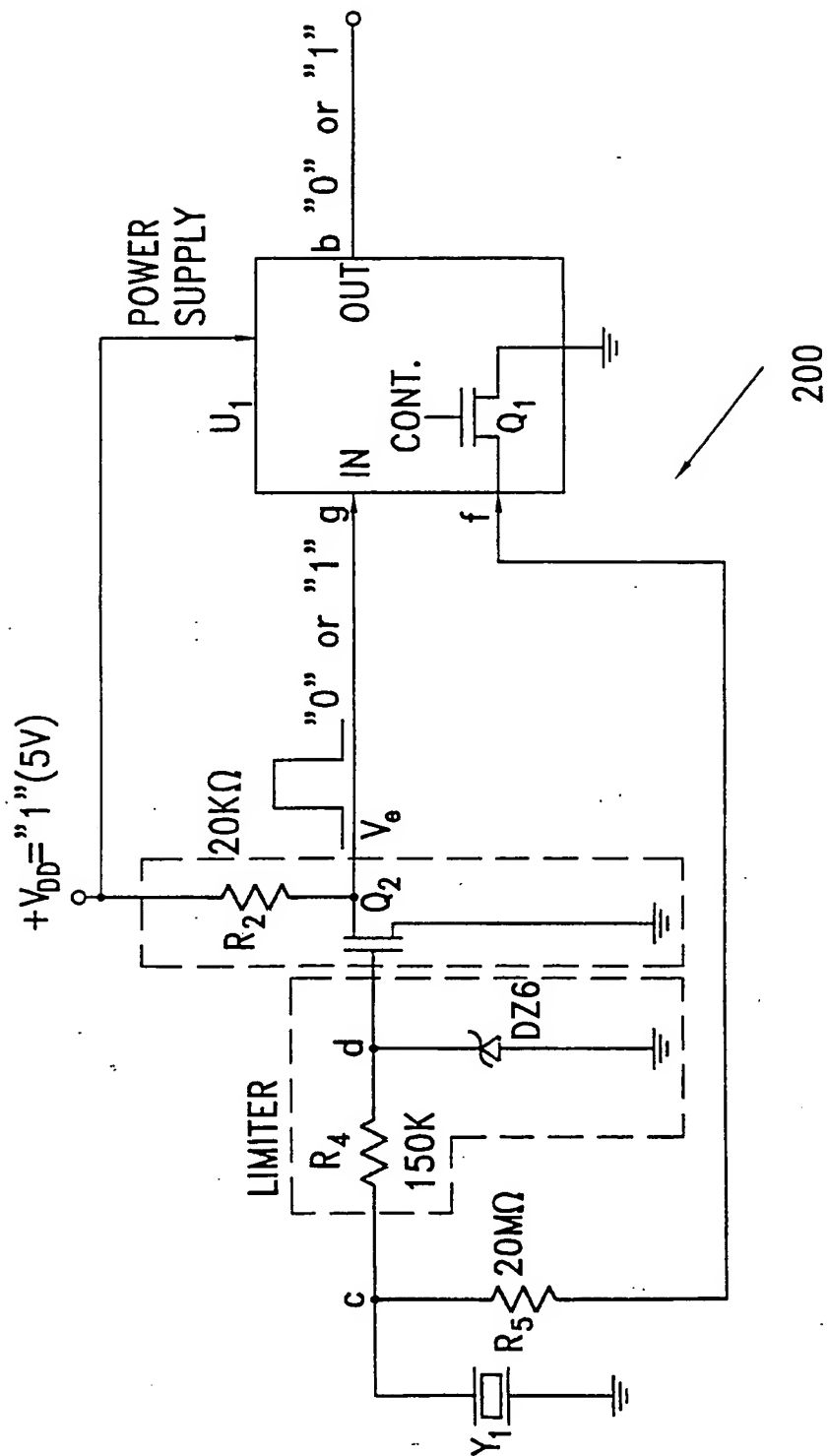
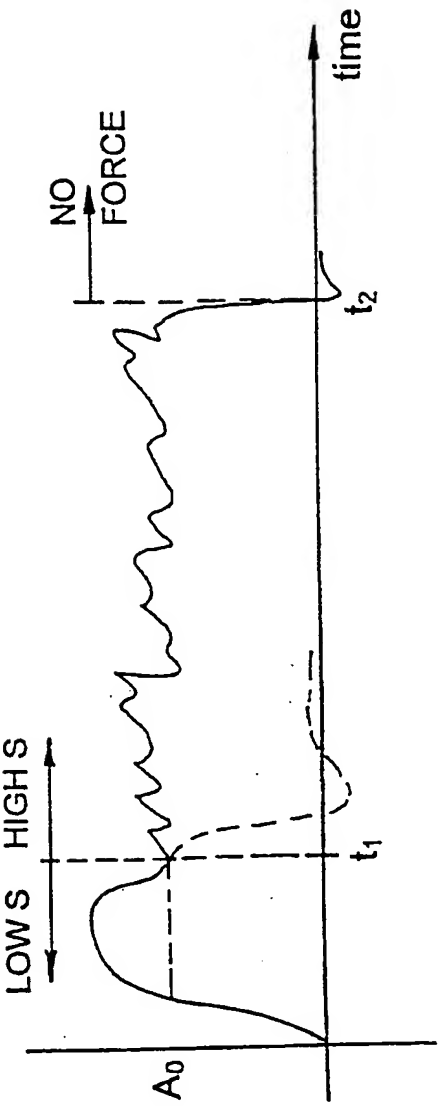
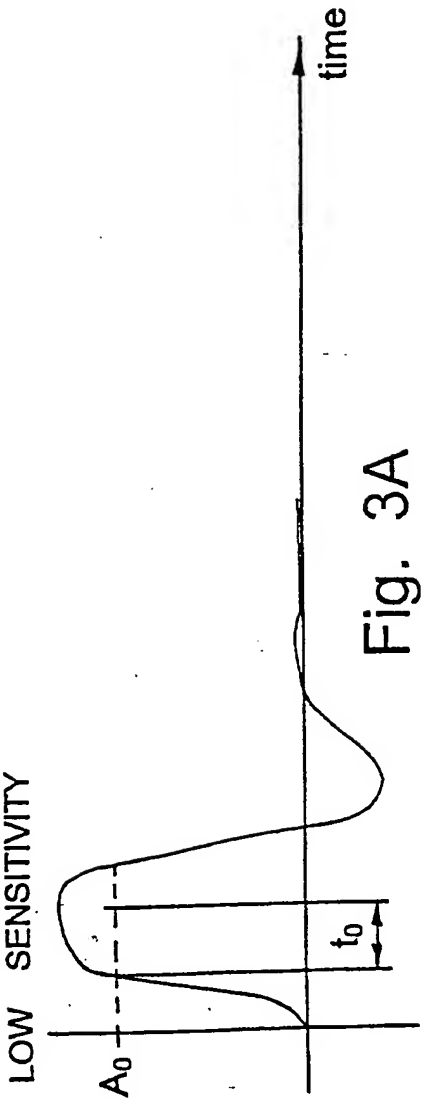


Fig. 2





# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/IL 00/00577

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H03K17/96 H01H57/00 H01L41/04

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H03K H01H H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 295 486 A (HAYWARD GILBERT OSBORNE) 29 May 1996 (1996-05-29) page 2, line 14 -page 5, line 18; figures 1-3	1-21
A	US 5 442 150 A (IPCINSKI RALPH G) 15 August 1995 (1995-08-15) column 4, line 37 -column 5, line 7; figures 19,20 column 6, line 37 -column 6, line 63; figure 35	1-21
A	EP 0 553 881 A (ESSEX ELECTRONICS INC) 4 August 1993 (1993-08-04) column 3, line 4 -column 7, line 3; figures 1-5	1-21
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
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- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

13 February 2001

Date of mailing of the international search report

20/02/2001

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 00/00577

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 675 600 A (WHITAKER CORP) 4 October 1995 (1995-10-04) column 3, line 24 -column 11, line 31; figures 1-12 ---	1-21
A	US 5 170 087 A (KARR BARRETT ET AL) 8 December 1992 (1992-12-08) column 4, line 53 -column 11, line 16; figures 7-12 ---	1-21
A	DE 24 33 208 A (SIEMENS AG) 7 August 1975 (1975-08-07) the whole document ---	1-21
A	PATENT ABSTRACTS OF JAPAN vol. 005, no. 117 (E-067), 28 July 1981 (1981-07-28) -& JP 56 056037 A (MATSUSHITA ELECTRIC IND CO LTD), 16 May 1981 (1981-05-16) abstract ---	1-21
A	EP 0 324 228 A (US ELEVATOR CORP) 19 July 1989 (1989-07-19) column 4, line 17 -column 7, line 20; figures 2-7 ---	1-21
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 02, 26 February 1999 (1999-02-26) -& JP 10 307661 A (INTERNATL BUSINESS MACH CORP &LT;IBM&GT;), 17 November 1998 (1998-11-17) abstract ---	1-21
A,P	-& US 5 982 304 A (SELKER EDWIN JOSEPH, BETTS JONATHAN NOBLE) 9 November 1999 (1999-11-09) column 2, line 29 -column 2, line 54; figure 3 ---	1-21
A	EP 0 343 685 A (MAKASH ADVANCED PIEZO TECH) 29 November 1989 (1989-11-29) cited in the application page 4, line 53 -page 5, line 7; figure 4 ---	1-21

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int .tional Application No

PCT/IL 00/00577

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
GB 2295486	A	29-05-1996	NONE	
US 5442150	A	15-08-1995	NONE	
EP 0553881	A	04-08-1993	US 5231326 A	27-07-1993
			CA 2088425 A	31-07-1993
			DE 69303628 D	22-08-1996
			DE 69303628 T	06-02-1997
			GB 2263813 A, B	04-08-1993
EP 0675600	A	04-10-1995	JP 7282699 A	27-10-1995
			US 5673041 A	30-09-1997
US 5170087	A	08-12-1992	NONE	
DE 2433208	A	07-08-1975	GB 1470111 A	14-04-1977
			GB 1470112 A	14-04-1977
			IT 1009356 B	10-12-1976
JP 56056037	A	16-05-1981	NONE	
EP 0324228	A	19-07-1989	US 4805739 A	21-02-1989
			EP 0471901 A	26-02-1992
			US 4951787 A	28-08-1990
JP 10307661	A	17-11-1998	US 5982304 A	09-11-1999
EP 0343685	A	29-11-1989	US 4896069 A	23-01-1990
			AT 103125 T	15-04-1994
			DE 68913808 D	21-04-1994
			DE 68913808 T	28-07-1994
			ES 2050183 T	16-05-1994
			JP 3184220 A	12-08-1991
			JP 7031959 B	10-04-1995

-18-

3. Method according to claim 1, comprising providing the switch of a derivation to its electronic circuit and passing it from the default to the transitory mode and vice versa by changing increasing and respectively decreasing the resistance of said derivation.

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### CLAIMS

1. Method of producing an activating signal by exerting pressure on a pressure-sensitive element, which comprises the steps of:

1 - providing an electronic circuit in which said pressure-sensitive element is inserted, that has two modes, a default mode and a transitory mode;

2 - normally keeping said circuit in the default mode, in which it generates a primary activating signal, in the same manner and under the same conditions as a conventional pressure-sensitive switch, when an operator produces a primary pulse, having amplitude and duration not below predetermined thresholds, by applying pressure to the pressure-sensitive element;

3 - when the primary activating signal has been generated, or concurrently with its generation, switching said circuit to the transitory mode, in which it generates secondary activating signals, in response to secondary pulses produced by pressures lower than the pressure that has produced said primary pulse; and

4 - returning the electronic circuit to its default mode, when no secondary pulses have been produced for a predetermined period of time.

2. Method according to claim 1, wherein the pressure which produces the primary activating signal is the pressure of an operator's finger on the pressure-sensitive element and the pressures which produce the secondary activating signals are generated by vibrations of the operator's finger which continues to apply pressure to the pressure-sensitive element.